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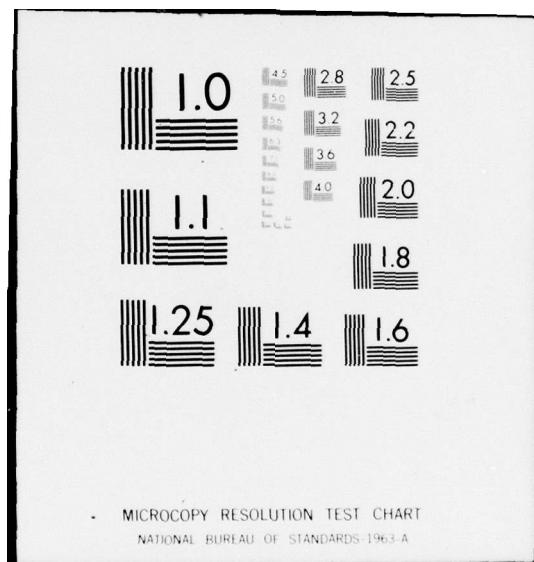
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SUPPRESSIVE SHIELDING

FINAL REPORT

April 1977

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AAI CORPORATION
Cockeysville, Maryland

Contract DAAA15-75-C-0120



US ARMY ARMAMENT RESEARCH AND DEVELOPMENT COMMAND
Chemical Systems Laboratory
Aberdeen Proving Ground, Maryland 21010

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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) <table> <tbody> <tr> <td>(U)Door design</td> <td>Explosive waste</td> <td>81-mm Suppressive Shield</td> </tr> <tr> <td>Closure design</td> <td>Waste removal</td> <td>Cavity-facing operation</td> </tr> <tr> <td>CAD-E</td> <td>Explosive dusts</td> <td>Category 4 shield</td> </tr> <tr> <td>Interactive computer graphics</td> <td>Shielded disposal</td> <td>Category 6 shield</td> </tr> </tbody> </table>			(U)Door design	Explosive waste	81-mm Suppressive Shield	Closure design	Waste removal	Cavity-facing operation	CAD-E	Explosive dusts	Category 4 shield	Interactive computer graphics	Shielded disposal	Category 6 shield
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(Keywords continued on reverse side)														
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) <p>(U) A summary of what was accomplished in each of ten tasks of the Suppressive Shield contract DAAA15-75-C-0120 is given.</p>														

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19. KEYWORDS (Contd)

(U)Underground disposal	Welded hemispheres	Testing explosively
Hydrostatic testing	Sliding personnel door	Hawk site
Rotating product door	Hawk missile	Cost estimates
Penetrations	Radar interference	Shield group 1 modification
Openings	Blast effects	Shield design handbook
Fragment effects	Handbook chapter	Suppressive shield removal

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I. INTRODUCTION

The objective of this contract was to provide services on a task assignment basis for the investigation of the operational analysis of applying suppressive shields to a variety of special case problems, operating problems, design hardware solutions and provide standard operating procedures in connection with the installation and maintenance of suppressive shields in specific plants.

This report presents a summary of the results of the ten tasks assigned under the contract.

II. SUMMARY OF TASKS ASSIGNED

A. Task 1 - Category 6, Doors and Closures

The objective of this task assignment was to examine a specific application of a Category 6 Shield relative to the closure methods and doors required and to fabricate a test unit capable of demonstrating the applicability of the closure/door design(s) chosen to meet actual operating conditions.

1. Results of Task Assignment

A shield design suggested by the Government was discussed at several meetings and fabrication drawings were made. The shield was fabricated from mild steel and delivered to the BRL for testing. A test was conducted at BRL on August 19, 1975. The latches holding the top hemisphere to the bottom one failed and the sphere which forms the Category 6 Shield, separated. The explosive charge was two 1/2 ounce cups of pentolite and since the design charge was twelve times this amount, an investigation was conducted. It was decided to change the Category 6 Shield design by welding the hemispheres together. This effort was accomplished under Task Assignment 5.



2. Items Delivered

The test shield was delivered for testing to the BRL, Aberdeen Proving Ground, Md. The drawing of the shield was sent to the Corps of Engineers, Huntsville, Alabama in accordance with direction provided by the Contract Project Officer.

B. Task 2 - Computer Aided Design of Suppressive Shields

The objective of this task was to determine the feasibility of applying CAD-E with Interactive Computer Graphics to the design and design evaluation of optimized, safety approved suppressive shields.

1. Results of Task Assignment

This task resulted in a technical report which showed recommended concepts, equipment requirements, cost factors and trade-offs. In order to prepare this report, it was necessary to:

- a. review the engineering design handbook outline, data displays and design procedures.
- b. collect graphics software that is already available at Edgewood.
- c. survey the market for available computer equipment
- d. prepare a conceptual block diagram model for a computer facility to apply current CAD-E technology, with and/or without interactive computer terminals, to the engineering design of suppressive shielding for munitions production operations, making maximum use of the existing computer equipment at Edgewood.
- e. collect cost data on equipment acquisition, rental and operation.
- f. estimate engineering man hours and computer cost for operation of the CAD-E facility and trade-off against the cost for hand calculations assuming the availability of an engineering handbook similar to the current TM5-1300 for concrete barricades.



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2. Items Delivered

The final report was prepared in Government format and distributed as EM-CR-76080, dated June 1976.

C. Task 3 - Explosive Waste Removal

The objective of this task assignment was to establish engineering guidelines and specifications suitable for designing an explosive waste removal system for use in conjunction with suppressive shields.

1. Results of Task Assignment

The work accomplished consisted of a study of methods of safely removing explosive dust and chips from within suppressive shields, and the preparation of engineering guidelines for the design of such systems. This study investigated the problems associated with removing the waste products produced during the manufacture of various munitions and specifically addressed the task of defining a method of waste removal which would insure that accidental fire or explosion could not result in injury to personnel. A number of different waste removal concepts were examined and two were determined to fulfill the requirements for safety, reliability and practicality.

The baseline system selected for the study was the 81MM mortar round drill and facing operation on the modernized C line at Milan AAP. A number of visits were made to both Edgewood and Milan AAP to obtain inputs necessary to formulate design criteria. Candidate concepts were then generated, analyzed and evaluated. Two concepts were selected (a shielded disposal line and an underground disposal line) and analyzed in more detail.

A final report was prepared detailing the investigations and presenting the results of the study.



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2. Items Delivered

The final report was prepared in Government format and distributed as EM-CR-76002, dated August 1975.

D. Task 4 - Operational Readiness of Suppressive Shield for 81MM at Milan AAP

The objective of this task is to conduct an engineering analysis and evaluation to identify the tasks required to install the 81MM suppressive shield on an operating line. The results of this task were to be submitted in a letter report.

1. Results of Task Assignment

The study was based on discussions with Edgewood and Milan AAP personnel and a tour of the existing 81MM assembly line. Since the layout of the facilities and the equipment design for the modernized line were not finalized, the study had to be based upon the latest available information. All probable hazardous operations were considered with the cavity facing operation being the only operation identified as definitely requiring a suppressive shield.

The application of a suppressive shield to this operation was considered in detail and documented in the final report.

2. Items Delivered

The final report was prepared in contractor format and submitted to Edgewood. The AAI Report Number is ER-8375, dated July 1975.

E. Task 5 - Category 6 Adaptation

The objective of this task was to fabricate and test a Category 6 shield to be adapted for use as a laboratory storage container for explosive samples. Two shields were to be fabricated, one to be explosive tested and the other to be hydrostatic tested.



1. Results of Task Assignment

Shop drawings of the shield were prepared from sketches and notes provided by the Project Officer. This shield differed from the Category 6 shield fabricated under Task 1 in that it was to be stainless rather than mild steel, it was to have the hemispheres welded together and it was to have a double door arrangement much different from the Task 1 configuration. During preparation of the fabrication drawings, the Task 1 Category 6 shield was tested and failed at much lower than design charge-weight. The subsequent investigation resulted in a higher design pressure being specified and in an extensive re-design of the door reinforcement on the Task 5 shield. The Battelle method of analysis was used. It was also decided that one shield would be built and tested before proceeding with the second one.

The shield was tested and withstood explosion from the design charge weight. When the charge weight was increased to about 3 1/2 times the design value, the shield failed causing considerable damage to the test area and instrumentation. Nevertheless the testing was successful at the design level and the second sphere was fabricated and successfully hydrostatic tested. It was directed by the Contract Project Officer that the second shield be shipped to Mound Laboratories.

2. Items Delivered

The second shield was shipped to Mound Laboratories on January 17, 1976. The drawings of the shield were sent to the Corps of Engineers, Huntsville, Alabama at the direction of the Contract Project Officer.



F. Task 6 - 81MM Door Safety Approval Package

The objective of this task assignment was to prepare a safety approval package for the 81MM doors to complete safety approval of the 81MM shield.

1. Results of Task Assignment

Using Government furnished data, a report was prepared for submission for safety approval of the 81MM door systems. The sliding personnel door and the rotating product door had been installed in a Category 4 shield to expedite the testing. Photographs, test data and sketches were organized into a report as evidence of the fulfillment of requirements for safety approval of the sliding personnel door and rotating product door in the 81MM ^{motor} shield.

2. Items Delivered

The final report was prepared in Government format and submitted to Edgewood as EM-CR-76018, dated September 1975.

G. Task 7 - Preparation of Engineering Design Guidelines, Drawings and Specifications for Operational Applications of Suppressive Shielding

The objective of this task assignment was to prepare engineering design guidelines, drawings and specifications for the incorporation of various openings and penetrations required in suppressive shields for personnel, equipment, utilities and environmental conditioning; and for interior and exterior shield liners.

1. Results of Task Assignment

The work accomplished included:

a. A survey of representative Army Ammunition Plants in which suppressive shielding could be utilized in order to obtain data and information



applicable to the requirements for the penetrations and liners.

b. Conducting analyses to determine which of the penetrations and openings could be recommended for safety approval without explosive testing.

c. Preparation of engineering guidelines, drawings and specifications for the various openings, penetrations and liners from criteria formulated in concert with the cognizant Government personnel.

d. Preparation of test plans for those openings and penetrations requiring testing.

e. Preparation of a final comprehensive technical report.

2. Items Delivered

The final report was prepared as a result of the investigations and analyses together with inputs and suggestions from a number of Government personnel. This report was prepared in Government format and distributed as EM-CR-76097, dated December 1976. The drawings of the penetrations were sent to the Corps of Engineers, Huntsville, Alabama as directed by the Contract Project Officer.

H. Task 8 - Feasibility Study of the Operational Integration of the Tactical Improved Hawk Site Suppressive Shielding

The objective of this task assignment was to perform an engineering study of the problems of rapid removal of suppressive shields around operational Hawk missile tactical launch sites and to eliminate or counteract site radar interference from suppressive shielding installed at the launch site.

1. Result of Task Assignment

An engineering study was conducted to ascertain the technical feasibility of utilizing suppressive shields to eliminate the hazards presented



by the inadvertant detonation of an Improved Hawk missile. The study established which sites presented a hazard, determined blast and fragment effects of the missile, established design criteria for a suppressive shield to defeat the blast and fragment effects, prepared concepts for the rapid removal of a suppressive shield, prepared cost estimates for the concepts and analyzed possible radar interference by the shield.

2. Items Delivered

A final report was prepared in Government format and distributed as EM-CR-76057, dated February 1976.

I. Task 9 - 1/4 Scale Shield Group 1 Modifications

The objective of this task assignment was to modify the 1/4 scale Shield Group 1 structure in accordance with instructions given by the Government.

1. Results of Task Assignment

The following modifications were accomplished:

- a. The three support rings around the shield were removed.
- b. The corrugated steel liner was removed and the welds on one side of each closure stip were cut.
- c. A new frame and a new door to the shield were fabricated and installed in accordance with drawings provided by the Government.
- d. A 22 gauge corrugated double liner was installed inside the shield.
- e. A new center ring was installed around the outside of the shield.



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2. Items Delivered

Materials necessary to modify the shield were delivered to the test site at BRL and installed as required.

J. Task 10 - Preparation of Suppressive Shield Design Handbook - Chapter 2, Structural Details

The objective of this task assignment was to prepare descriptions and discuss details of utility penetrations, interior liners and personnel/conveyor openings in a format suitable for inclusion in the suppressive shield engineering design handbook.

1. Results of Task Assignment

A series of draft handbook sections were prepared, reviewed with cognizant personnel, revised and re-submitted. The chapter number was changed from 2 to 6 and various format and content revisions were made until the Corps of Engineers representative was satisfied.

2. Items Delivered

A draft of the handbook section, Chapter 6, Structural Details was submitted as AAI Report No. 8889, dated March 1977. A final discussion meeting was held on April 20, 1977 to go over the draft handbook chapter.